

# intellus

LEARNING  
OPEN COURSES



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*2017 - United Nations 2nd World Open Educational Resources Congress*

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*The added value of scaffolded materials so students can continuously assess and progress through the content. - Educator from Pikes Peak CC*

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# University Physics 1

## Course Overview

# Acknowledgments

This presentation is based on and includes content derived from the following OER resource:

## **University Physics, Volumes 1 and 2**

The OpenStax books used for this course may be downloaded for free at:

<https://openstax.org/details/books/university-physics-volume-1>

<https://openstax.org/details/books/university-physics-volume-2>

# Units and Measurement

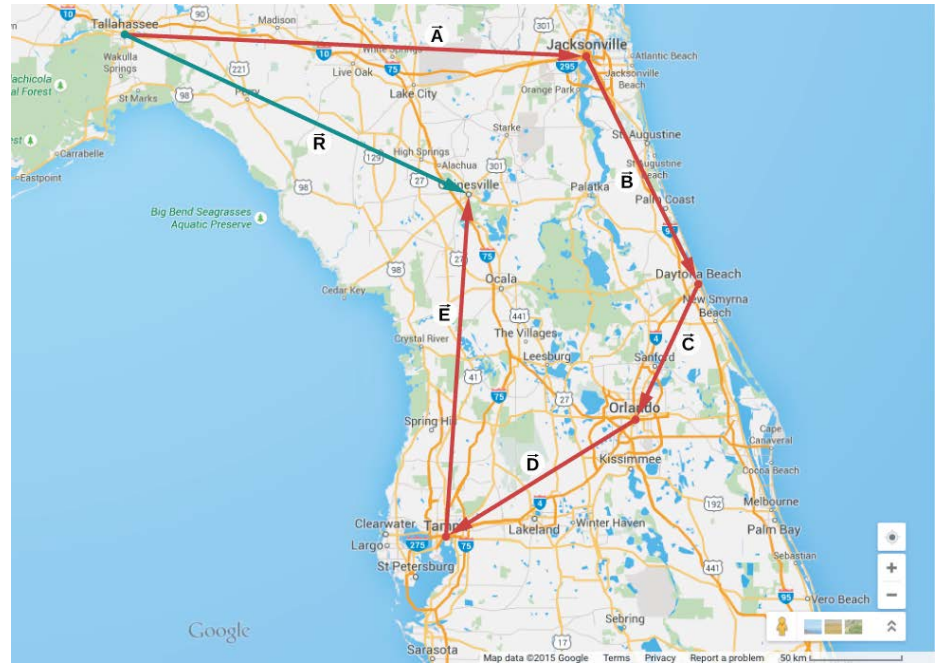
Physics is concerned with every aspect of the physical world from the very small to the very large. Learning how we measure various basic quantities, communicate them to other researchers and the public, and solve problems in physics is the first step to understanding a wide variety of physical phenomena.



(University Physics Volume 1. OpenStax. Fig. 1.1.)

# Vectors

Vectors are a mathematical concept that describe quantities with both magnitude and direction, and they are an essential tool of physics. Many important quantities, including positions and velocities, are described by vectors, and sums and products of vectors allow us to describe a huge variety of phenomena.



(University Physics Volume 1. OpenStax. Fig. 2.11.)

# Motion Along a Straight Line

Kinematics is the study of motion without considering its causes. Studying motion along a straight line provides an introduction to the relationships between position, velocity, and acceleration without the complicating factors of motion in two and three dimensions. In particular, motion with constant acceleration is emphasized.



(University Physics Volume 1. OpenStax. Fig. 3.10.)



# Motion in Two and Three Dimensions

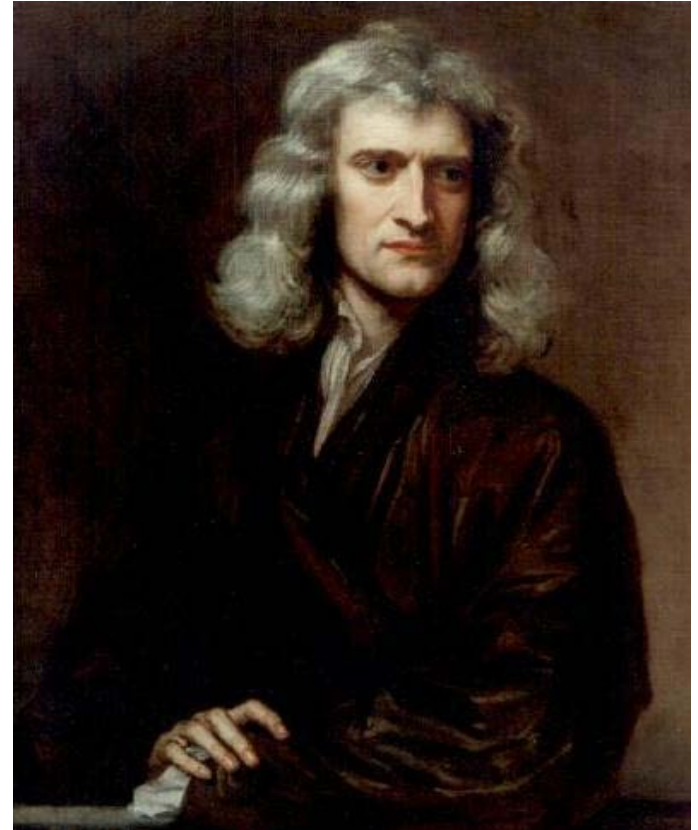
Kinematics in one dimension can easily be extended to two and three dimensions in order to describe many more phenomena. In particular, projectile motion and circular motion are emphasized, due to their importance in many areas of physics.



(University Physics Volume 1. OpenStax. Fig. 4.1.)

# Newton's Laws of Motion

Newton's laws of motion are the foundation for dynamics, the study of how forces affect the motion of objects. They define the relationship between acceleration and the net forces acting on an object, and provide the theoretical basis on which much of physics is built.



(University Physics Volume 1. OpenStax. Fig. 5.2.)

# Application of Newton's Laws

Newton's laws can be applied to a wide variety of situations to explain why an object moves in the way it does. The forces of friction and drag are described in order to explain the real-world slowing of objects, and centripetal force is described to explain the causes of circular motion.



(University Physics Volume 1. OpenStax. Fig. 6.1.)

# Work and Kinetic Energy

The concepts of work and kinetic energy can be used as an alternative method of describing the motion of objects. They are especially useful when the application of Newton's laws is difficult or impossible to solve analytically. The transformation of work into kinetic energy is described by the work-energy theorem.



(University Physics Volume 1. OpenStax. Fig. 7.1.)

# Potential Energy and Conservation of Energy

Potential energy is a type of energy that describes the ability of an object to do work. The conservation of energy states that the total energy of an object, or the sum of its kinetic and potential energies, is constant when it is acted on by conservative forces that do no work. Otherwise, the change in the object's energy is equal to the work done on it.



(University Physics Volume 1. OpenStax. Fig. 8.3.)

# Linear Momentum and Collisions

The momentum of an object is the product of its mass and velocity. When acted on by a force or undergoing a collision, the momentum of the object is changed according to Newton's second law. Like energy, momentum is a conserved quantity for a closed system acted on by no external forces.



(University Physics Volume 1. OpenStax. Fig. 9.1.)

# Fixed-Axis Rotation

Rotation can be described analogously to linear motion. In fact, all of the concepts previously described for linear motion generalize to angular motion. The rotational analogue of force is torque and the rotational analogue of momentum is angular momentum. General concepts like Newton's second law, work, and energy also extend to the study of rotation.



(University Physics Volume 1. OpenStax. Fig. 10.1.)

# Angular Momentum

Angular momentum is the rotational analogue of linear momentum. We start with the simple case of rolling objects and extend our study of angular momentum to other rigid bodies. Like linear momentum, angular momentum is a conserved quantity.



(University Physics Volume 1. OpenStax. Fig. 11.1.)



# Static Equilibrium and Elasticity

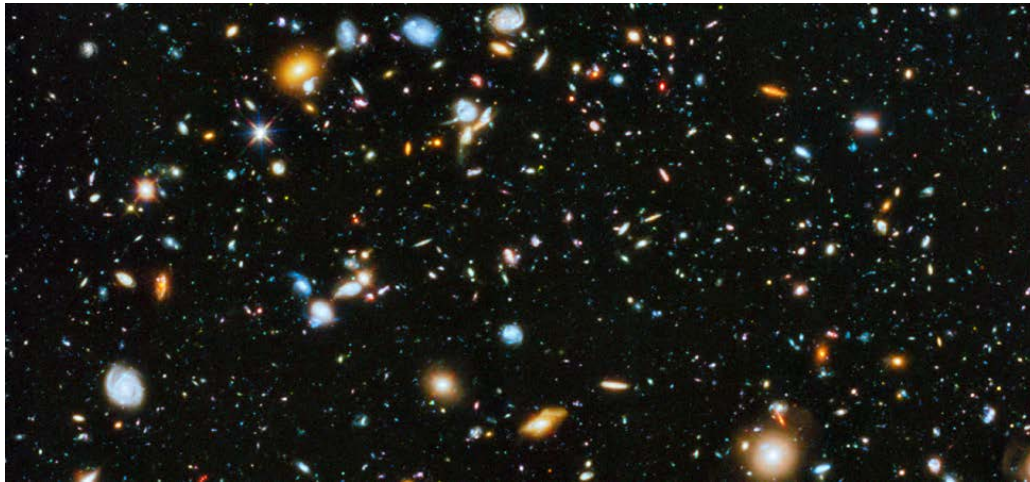
Up to this point, we have assumed that objects are perfectly rigid. In reality, the forces acting on an object cause it to deform. The degree to which it deforms under a given force is determined by the object's elasticity. Static equilibrium occurs when the restoring force applied by the deformed object balances the forces causing the deformation.



(University Physics Volume 1. OpenStax. Fig. 12.20.)

# Gravitation

The gravitational force is one of only four known fundamental forces. Its pull keeps the planets in orbit around the Sun and keeps us standing on the Earth. Newton's universal law of gravitation describes how the gravitational force varies with the masses of two objects and their distance. The applications to satellite and planetary orbits are emphasized.



(University Physics Volume 1. OpenStax. Fig. 13.1.)

# Fluid Mechanics

Fluid mechanics is the study of substances that flow, like liquids and gases. The concept of pressure, or force per area, has important applications in fluids, and its effect on fluid flow is explored. In addition, the conservation of energy, or Bernoulli's equation, is used to understand the behavior of both static and dynamic fluids.



(University Physics Volume 1. OpenStax. Fig. 14.1.)

# Temperature and Heat

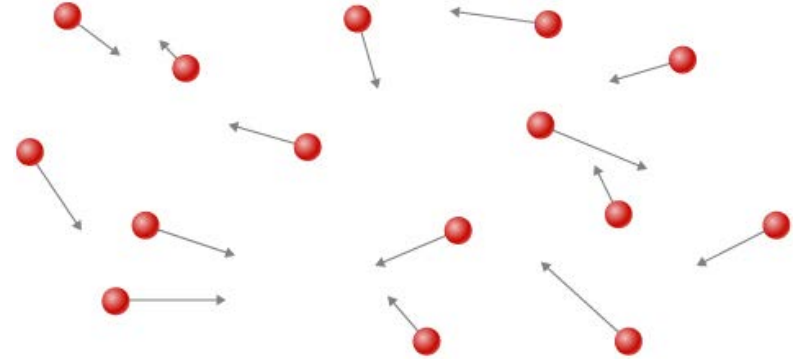
Temperature is defined operationally as the quantity measured by a thermometer, and heat is defined as the energy that flows between objects at different temperatures. Changes in temperature can have interesting effects on a substance, like thermal expansion and phase changes.



(University Physics Volume 2. OpenStax. Fig. 1.1.)

# The Kinetic Theory of Gases

The kinetic theory of gases relates the macroscopic quantities that describe a gas to the molecular motion of the gas constituents. Pressure is explained as the force exerted by collisions of gas molecules with the walls of its container, and temperature is interpreted as the average kinetic energy of the gas molecules. The consequences of this theory are both remarkable and useful.



(University Physics Volume 2. OpenStax. Fig. 2.2.)

# The First Law of Thermodynamics

The first law of thermodynamics states that the change in energy of a thermodynamic system is given by the difference in the heat added and the work done by the system. We clearly define what this means, then explore several types of processes that hold one thermodynamic variable constant, and the effect of each of those processes on the energy of a system.



(a)

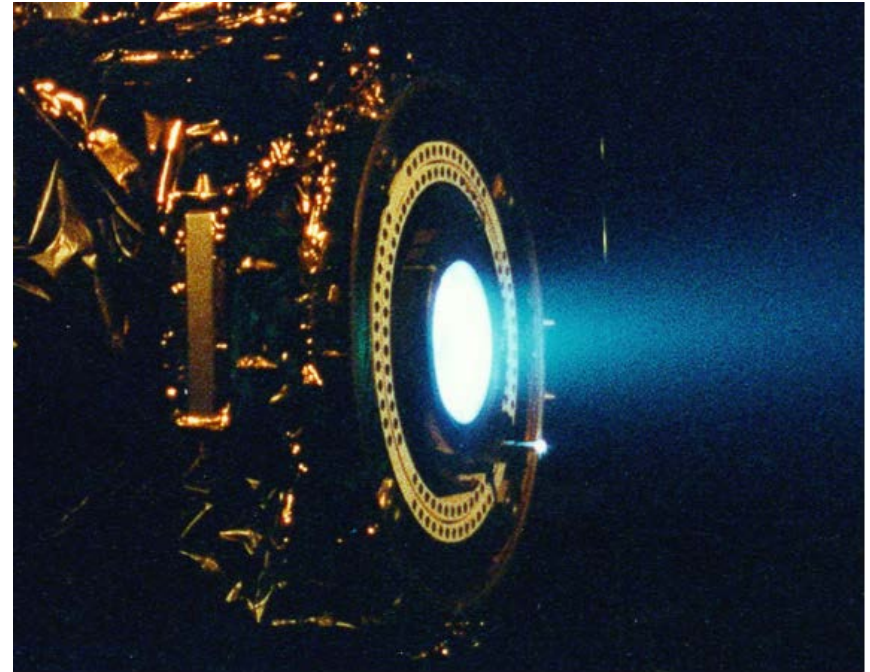


(b)

(University Physics Volume 2. OpenStax. Fig. 3.3.)

# The Second Law of Thermodynamics

The second law of thermodynamics, which can be written in many equivalent ways, expresses the idea that heat naturally flows from hotter to colder objects. Engines and refrigerators take advantage of this to produce work or cold conditions. The second law implies that the disorder, or entropy, of the universe may only increase.

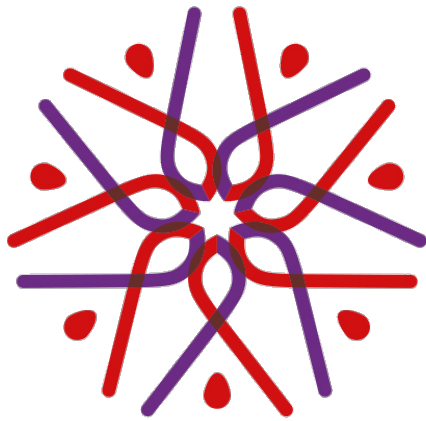
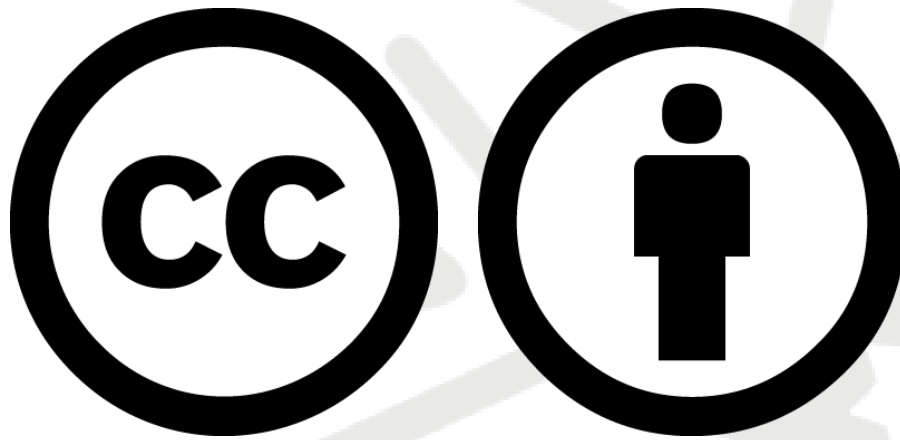


(University Physics Volume 2. OpenStax. Fig. 4.1.)

# Study Tips

- Read the syllabus or schedule of assignments regularly.
- Understand key terms; look up and define all unfamiliar words and terms.
- Take notes on your readings, assigned media, and lectures.
- As appropriate, work all questions and/or problems assigned and as many additional questions and/or problems as possible.
- Discuss topics with classmates.
- Frequently review your notes. Make flow charts and outlines from your notes to help you study for assessments.
- Complete all course assessments.





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